MO 241
Varieties of intentions
Parametric activation of the anterior paracingulate cortex in theory of mind tasks

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Introduction

According to Theory of Mind (TOM), humans have a special ability to understand and interpret intentions of other people also known as mindreading. Neuroimaging studies have shown the existence of a distributed neural system underlying TOM (Gallagher et al. 2003). From these studies it has been concluded that a subregion of the medial prefrontal cortex is specifically involved in the representation of mental states of others, namely the anterior paracingulate cortex (PCC). However, the designs used in neuroimaging studies do not allow to distinguish between representation of intentions of others acting in isolation (intention in action) and the intentions of others involved in social interaction. Based on evolutionary considerations, we hypothesised that anterior PCC activation is sensitive to the degree of social interaction in TOM task. Therefore, we predicted anterior PCC to be activated parametrically in the following order: intentions in action in isolation < intentions for future social interaction < intentions in actual social interaction.

Methods

12 (6 male, 6 female) healthy right-handed volunteers (age range: 19-27 years) were studied with fMRI. We used cartoons involving a sequence of three pictures followed by a selection of three pictures of which the subjects had to choose the correct ending of the cartoon. There were four conditions: (i) physical causality (only objects, no persons, no intentions = control condition), (ii) intention in action (one person, simple intentions), (iii) intention for future social interaction (one person intending to socially interact), (iv) intentions in social interaction (two persons interacting with gestures). fMRI imaging: Magnetom Symphony (Siemens, Erlangen, Germany), single-shot EPI-sequence, TE/TR 40/2250 ms, 25 slices. Image processing and data analysis: SPM99 (Wellcome Institute of Cognitive Neurology, London). Results are from second level random effect analysis with $p<0.001$ on the voxel and $p<0.05$ on the cluster level (both uncorrected).

Results

Behavioural results: No significant differences in accuracy and correctness. FMRI-results: Compared to the control condition (i), typical TOM activation patterns (anterior PCC, anterior temporal pole and superior temporal cortex) emerged only in condition (iii) and (iv). Anterior PCC showed the predicted pattern with no significant activation for simple intentions in action, intermediate activation in the intentions for future social interaction condition and strong activation in the actual social interaction condition.

Conclusion

Our data show that anterior PCC activation occurs only if the interpretation of cartoon stories is related to social interaction (real or only implied) but not when simple intentions in action of isolated persons are represented. This has implications for the design of TOM stories in future studies as well as for the characterisation of TOM abilities in general.

References

Gallagher HL et al (2003) Trends in Cognitive Sciences 7: 77-83.